

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau(43) International Publication Date
22 February 2001 (22.02.2001)

PCT

(10) International Publication Number
WO 01/12431 A1(51) International Patent Classification⁷: **B32B 9/00,**
C22C 29/00, C23C 4/06[—/US]; 10 Campbells Brook Road, Whitehouse Station,
NJ 08889 (US). **SKANDAN, Ganesh** [—/US]; 342 Lunar
Road, Piscataway, NJ 08854 (US).

(21) International Application Number: PCT/US00/22340

(22) International Filing Date: 16 August 2000 (16.08.2000)

(74) Agent: **SCHWARZ, Paul, A.**; Buchanan Ingersoll, P.C.,
4th floor, 650 College Road East, Princeton, NJ 08540
(US).

(25) Filing Language: English

(26) Publication Language: English

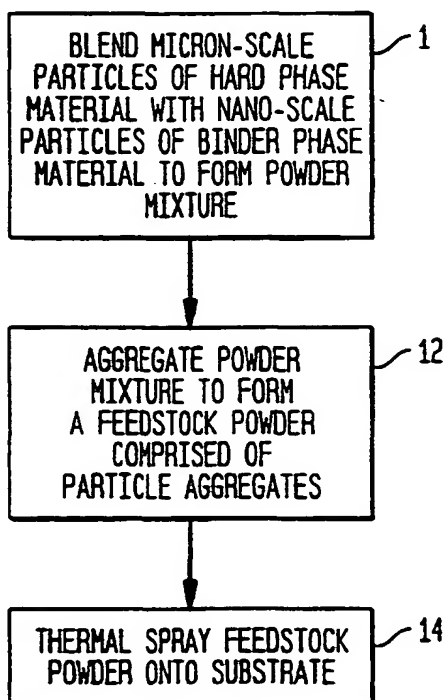
(30) Priority Data:
60/149,128 16 August 1999 (16.08.1999) US(81) Designated States (*national*): AE, AL, AM, AT, AU, AZ,
BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK,
DM, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL,
IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU,
LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT,
RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA,
UG, US, UZ, VN, YU, ZA, ZW.(71) Applicants (*for all designated States except US*): **RUT-
GERS, THE STATE UNIVERSITY** [US/US]; 58 Bevier
Road, Piscataway, NJ 08854-8010 (US). **NANOPOW-
DER ENTERPRISES INCORPORATED** [US/US]; 120
Centennial Avenue, Piscataway, NJ 08854-3908 (US).(84) Designated States (*regional*): ARIPO patent (GH, GM,
KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian
patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European
patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE,
IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG,
CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

(72) Inventors; and

(75) Inventors/Applicants (*for US only*): **KEAR, Bernard, H.**

[Continued on next page]

(54) Title: MULTIMODAL STRUCTURED HARDCOATINGS MADE FROM MICRO-NANOCOMPOSITE MATERIALS



(57) Abstract: A thermal spray method for the fabrication of ceramic/metal and ceramic/ceramic hardcoatings for wear applications. The method makes use of feedstock powder, composed of micron-scale aggregates of hard phase material particles that are either mixed or coated with a readily fusible nano-scale binder phase material (12). Thus, during thermal spraying (14), the nanostructured material undergoes rapid melding while the aggregated material is heated but not necessarily melted. A dense coating is formed when the molten nano-material fills the available pore spaces between the heated and softened aggregates, providing a strong and tough matrix for the consolidated material. Optimal wear properties are achieved when the volume fraction of aggregated particles is high, typically in the range 0.5-0.9. Aggregated material may be composed of one, two or more particles of different sizes and/or compositions, with particle size distribution that gives high packing density for the hard phase.

WO 01/12431 A1



Published:

- With international search report.
- Before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments.

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.